in Germany, where the Crown Princess seems to have evinced in this case her great interest in the country from which she came, and I believe it is mainly owing to her exertions and those of the Royal Family in that country that so far as Germany is concerned we are to be so ably assisted. It may not be uninteresting to the meeting that I should describe in a very few words what has been done in the present state of matters with regard to the exhibition. At meetings of the various sub-committees (appointed at the General Committee meeting in June last) during the months of February and November, reports were made of the results of visits to foreign countries by officers of the department. The sub-committees made various suggestions to the department as to objects to be procured. These have been acted upon, and many most interesting objects obtained. The committee also advised that gentlemen should be employed to visit various towns and leading manufacturers. This has been carried out with the best results by Prof. Shelley, Mr. Akroyd, Dr. Martin, Prof. Morris, Mr. Judd, and Mr. Norman Lockyer. The Foreign Secretary having through her Majesty's Ministers abroad urged the importance of co-operation on the part of foreign Governments, our appeal has been most cordially responded to. The Governments of Belgium, France, Germany, Holland, Italy, and Switzerland, have appointed committees to act in union with the general committee; and the Government of the United States has placed itself in communication with the various institutions and Government departments. Russia intends to contribute an interesting collection from the Pædagogical Museum; and the Russian Academy have formed a committee under Prof. Struve. The Austrian Minister of Instruction has taken the matter in hand for that country, and one of his officers, Mr. Fidler, is in correspondence with the Science and Art Department. I mention this to show you the intense interest that foreign countries have taken in the matter, and that to their assistance and co-operation we feel very much indebted. The appeals made to Government departments, scientific institutions, and men of science at home have been very well received. The Admiralty contributes a complete scientific outfit of a surveying ship, dredging apparatus, &c. The Post Office contributes as complete a historical collection of telegraphic apparatus as exists; much, however, unfortunately, has been broken up for want of a physical museum in which to deposit it. They also propose to communicate Greenwich time, and fire a time gun, to illustrate their method of communicating time throughout the country. The Trinity House, Ordnance Survey, Royal Observatory, and Geological Survey have also promised to contribute. From the War Office and India Office no replies have been received, but we understand they are taking steps to contribute several objects of interest, especially from the Royal Arsenal at Woolwich. The Royal Society contributes a most important collection, including some of Newton's apparatus. The Royal Institution contributes historical apparatus used by Faraday and others, and some of Dr. Tyndall's instruments. The Astronomical Society contributes Baily's apparatus for the Cavendish experiments, and Sir W. Herschel's telescope. The Geographical Society contributes maps and instruments. The Microscopical Society has promised to organise a collection of microscopes, which Mr. Sorby has especially in charge; the Horological Institute a collection of clock escapements, &c., and the Royal College of Surgeons has promised an interesting collection. King's College has promised to contribute the collection of the late Sir C. Wheatstone. At Owens College, Manchester, Professors Roscoe, Stewart, Schorlemmer, and Reynolds have promised to contribute valuable apparatus, as have also Professors Tait and Crum Brown at Edinburgh, and Sir W. Thomson at Glasgow. Trinity College, Dublin, has also promised to contribute. Contributions have been promised by the following noblemen and gentlemen, viz.:—Dr. Joule, Prof. Andrews, Mr. Gore, Lord Rosse, Mr. De la Rue, Lord Cork, Dr. Frankland, Prof. Guthrie, Mr. Norman Lockyer, Dr. Ball, Prof. O'Reilly, Prof. Barrett, and Prof. Stokes. Among instrument makers who will contribute specimens of their apparatus may be mentioned Messrs. Elliott, Apps, Browning, Adie, Grubb, Cooke, and Tisley. The following map makers will contribute:—Messrs. Stanford, Murby, and Keith Johnston. Numerous collections for teaching have been promised. Among these may be mentioned an exceedingly interesting collection prepared by Prof. Guthrie. All this apparatus is made out of simple materials by the students themselves. A committee, consisting of Dr. Stone, Dr. Pole, Mr. W. Chappell, and Mr. Baillie-Hamilton, are forming a most interesting collection illustrative of the scientific principles on which the construction of musical instruments is based. Mr. Markham is forming a collection of Arctic maps, Mr. F. Galton a collection of exploratory apparatus, Mr. Scott a collection of meteorological apparatus, and Dr. Mann a collection of instruments connected with atmospheric electricity. Various local committees have been formed to forward the objects of the Exhibition. Amongst them may be mentioned one at Leeds for Yorkshire, arising from the exertions of Prof. Thorpe. Among other interesting objects from Germany, we may look for some of Tycho Brahe's instruments, and the original air-pump of Otto von Guericke. From France we have as yet no very definite information, but we expect a very interesting collection, as the French Commission, consisting of members of the Academy of Sciences, have devoted considerable attention to the Exhibition, and the Conservatoire des Arts et Métiers have promised some of their finest things. From Italy it is hoped that some of the instruments used by Galileo, Torricelli, Volta, and Galvani may be obtained. In consequence of want of room in the South Kensington Museum, it is intended to hold the Exhibition in the western galleries of the buildings lately used for the Annual International Exhibitions, her Majesty's Commissioners having most obligingly placed them at our disposal for the purpose. I cannot overrate the advantages we have derived from the services of Mr. Norman Lockyer, who has been transferred temporarily to this department. Professors Guthrie and Goodeve have also assisted us most remarkably, and various learned societies have been invited to organise conferences and conversazioni." His Grace concluded by suggesting the desirableness of forming one or two sub-committees for the purpose of making the necessary arrangements for the reading of papers, conferences, and receptions, and expressing his confidence that a cordial welcome will be accorded to distinguished scientific visitors from other countries.

Dr. Hooker moved "that a sub-committee be formed, consisting of the presidents and one vice-president of each of the learned societies, to consider the reading of papers, conferences, and demonstrations; and, secondly, the arrangements for the receptions." Mr. Warren De la Rue seconded the motion, which was carried.

PROF. FLOWER'S HUNTERIAN LECTURES ON THE RELATION OF EXTINCT TO EXISTING MAMMALIA[1]

III.

ORDER *Proboscidea.*—This name has been appropriated to a well-marked group of animals, presenting some very anomalous characters, allied in many respects to the Ungulata, but belonging neither to the

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[1] Abstract of a course of lectures delivered at the Royal College of Surgeons "On the Relation of Extinct to Existing Mammalia, with Special Reference to the Derivative Hypothesis," in conclusion of the course of 1873. (See Reports in NATURE for that year.) Continued from p. 308.

Artiodactyle nor Perissodactyle type of that order. It has been thought that they possess some, though certainly not very close, affinities with the Rodentia, and also with the Sirenia. It is certain, however, that the two species of Elephant which are the sole living representatives of the order, stand quite alone among existing mammals, widely differing from all others in many parts of their structure, being in some respects, as in the skull, dentition and proboscis, highly specialised, though in others, as in the presence of two anterior venæ cavæ and in the structure of the limbs, retaining a low or generalised condition. A considerable series of extinct forms, extending back through the Pliocene and Miocene epochs, show the same type under still more generalised outlines. Though no true Proboscidians have as yet been found in any Eocene formations, certain recently discovered forms of that epoch from North America, if their affinities are rightly interpreted, may link them to some unknown primitive type of Perissodactyle Ungulate. The consideration of these will, however, be reserved until the next lecture.

All the true *Proboscidea* are arranged in three principal groups or genera—*Elephas*, *Mastodon*, and *Dinotherium*. Their molar teeth, by which the extinct species are chiefly known, present a remarkable series of modifications, from the comparatively simple tapiroid teeth of *Dinotherium*, with two or three strongly pronounced transverse ridges, and a normal mode of succession, to the extremely complex structure and anomalous mode of replacement found in the true Elephants. The intermediate conditions occur in the various species of Mastodon. In this genus the enamel-covered transverse ridges of each tooth are generally more numerous than in *Dinotherium*, and often complicated by notches, or by accessory columns attached to them, but in the unworn tooth they stand out freely from the crown, with deep valleys between. In the Elephants the ridges are still further increased in number, and are greatly extended in vertical height, so that, in order to give solidity to what would otherwise be a laminated or pectinated tooth, it becomes necessary to envelop and unite the whole with a large mass of cementum, which completely fills up the valleys, and gives a general smooth appearance to the organ when unworn ; but as the wear consequent upon the masticating process proceeds, the alternate layers of tissue of different hardness, cement, dentine, and enamel, which are disclosed on the surface, form a fine and very efficient triturating instrument. The modification of the tooth of a Mastodon into that of an elephant is therefore precisely the same in kind as that of the molar of a Palæotherium into that of a horse, or of the corresponding tooth of an early Artiodactyle into that of an ox. The intermediate stages, moreover, even as our knowledge already extends, are so numerous that it is not possible to draw a definite line between the two types of tooth structure. As regards the mode of succession, that of the modern elephants is, as before mentioned, very peculiar. During the complete lifetime of the animal there are but six molar teeth on each side of each jaw, with occasionally a rudimentary one in front, completing the typical number of seven. The last three represent the true molars of the ordinary mammals, those in front appear to be milk molars, which are never replaced by permanent successors, but the whole series gradually moves forwards in the jaw, and the teeth become worn away, and their remnants cast out in front, while development of others proceeds behind. The individual teeth are so large and the processes of growth and destruction take place so slowly, that not more than one, or portions of two teeth, are ever in place and in use in each side of each jaw at one time. On the other hand the Dinotherium, the opposite extreme of the Proboscidian series, has the whole of the molar teeth in place and use at one time, the milk molars having been vertically displaced by pre-molars in the ordinary fashion. Among Mastodons transitional forms occur in the mode of succession as well as in structure, many species showing a partial vertical displacement of the milk molars, and the same has been observed in one extinct species of Elephant (*E. planifrons*).

Abundant remains of fossil elephants have been found in Pleistocene and Pliocene deposits in many parts of Europe, including the British Isles, in North Africa, throughout the North American continent from Alaska to Mexico, and extensively distributed in Asia. These species are chiefly known and characterised at present by the teeth, some of which resemble the existing Indian, and some the African type, but the majority are intermediate between the two, and make the distinction between *Elephas* and *Loxodon* as different genera quite impracticable. Others, again, approach so closely in breadth and coarseness of the ridges, and paucity of cementium to the Mastodons, as to have been placed by some naturalists in that genus. These form the group or sub-genus called *Stegodon* by Falconer. The best known extinct species of elephant are *E. primigenius*, the Mammoth, very closely resembling the existing Indian Elephant, of Pleistocene age, extensively distributed throughout Northern and Central Europe, North Asia, and North America, though most of the remains attributed to it in the latter country may belong to another species, *E. Americanus*, De Kay, which, according to Leidy, includes *E. Columbi*, Falc. In the frozen soil of North Siberia, complete animals, with the flesh and hair upon them, are often found, and their tusks are still collected in large quantities and in a sufficiently perfect condition to be used as ivory. *E. antiquus* and *E. meridionalis* are two other species found in Britain as well as Europe generally, of rather earlier date, and inclining more to the *Loxodon* type, as also do two species found in the island of Malta, *E. mnaidriensis* and *E. melitensis*, the latter the smallest known species of the group, sometimes not exceeding three feet in height when adult. The *Stegodon* forms, *E. clifti*, *bombifrons*, and *insignis* of Falconer and Cautley, are all from India, which would appear, from the abundance of remains, variety of form, as well as the generalised characters of some, and the geological horizon (Lower Pliocene) to be the earliest habitation of the true elephant yet discovered.

The Mastodons are distinguished from the elephants principally by the form of the molar teeth ; the only absolutely distinguishing character, and that somewhat of an arbitrary one, being that the third, fourth, and fifth molars have an equal number of ridges, whereas in the elephants the third and fourth are alike, but the fifth has a larger number. In addition to the great incisor tusks of the upper jaw they often, but not invariably, have lower incisors, which are always wanting in the elephants. They are all gigantic animals, equalling or exceeding the recent elephants in size. Their remains have been found in Europe and Southern Asia in Miocene and Pliocene beds, but not of an earlier or later date. Two species, *M. arvernensis* and *M. borsoni*, occur in England in the Suffolk Red Crag. They have also been found in both South and North America. In the latter, *M. Americanus*, Cuv., *M. ohioticus*, Blumenb., with very simple ridged molars, is of Pleistocene age, its remains being found in great abundance and very perfect condition. It was, therefore, the last survivor of the genus. The Mastodons were divided by Falconer into three series called respectively *Trilophodon*, *Tetralophodon*, and *Pentalophodon*, according to the number of ridges upon the molar teeth.

The *Dinotheria* were also animals of elephantine proportions, strikingly characterised by the pair of huge tusks descending nearly vertically from the fore part of the lower jaw. The presence or absence of upper incisors has not yet been satisfactorily ascertained. The cranium was much depressed, differing from that of the elephants in the comparatively little development of the air-cells.

The remainder of the skeleton is imperfectly known, but apparently agrees in its general characters with the other Proboscideans. Its remains have been met with in abundance at Eppelsheim, near Darmstadt, and also in various other Miocene formations in the South of Germany, France, and Greece; in Asia Minor, Attock in the Punjab and Perim Island, but whether all belonging to one species (*D. giganteum*, Kaup.) or to several, the materials are not at present sufficient to determine. The genus has not hitherto been found in England or in America.

The gradual transition in the character of the molar teeth of various Proboscideans is well illustrated by the following table (compiled from Dr. Falconer's Memoirs) of the "ridge formula" of various species. The numbers are, however, only averages, and it must be remarked that the higher the numerical expression of the ridge formula in the species the more liable is the number of ridges to vary within certain limits, especially in the teeth of the lower jaw, where they are often in excess. Several species, apparently intermediate in ridge formula to those in the table, have since been discovered, as *Mastodon pentelici* and *andium*, which break down the distinction between the sections *Trilophodon* and *Tetralophodon*, and *Elephas melitensis* between *Loxodon* and *Euelephas*.

	Milk Molars.			True Molars.			Total.
	I.	II.	III.	I	II.	III.	
Dinotherium giganteum	1	2	3	3	2	2	13
Mastodon (*Trilophodon*) *americanus*	1	2	3	3	3	4	16
Mastodon (*Tetralophodon*) *arvernensis*	2	3	4	4	4	5	22
Mastodon (*Pentalophodon*) *sivalensis*	3	4	5	5	5	6	28
Elephas (*Stegodon*) *insignis*	2	5	7	7	8	10	39
Elephas (*Loxodon*) *africanus* ...	3	6	7	7	8	10	41
Elephas (*Loxodon*) *meridionalis* ...	3	6	8	8	9	12	46
Elephas (*Euelephas*) *antiquus* ...	3	6	10	10	12	16	57
Elephas (*Euelephas*) *primigenius* ..	4	8	12	12	16	24	76
Elephas (*Euelephas*) *indicus*	4	8	12	12	16	24	76

(*To be continued.*)

THE FIRST GENERAL GEOLOGICAL MAP OF AUSTRALIA [1]

FROM its vast size and its peculiar conditions of physical geography the island-continent of Australia presents formidable difficulties alike to the topographical and the geological surveyor. Of its wide desert interior we know nothing more than what has been seen or conjectured along the tracks of the few adventurous men who have penetrated it. The eastern and southern colonies have been more or less thoroughly geologised, and expeditions have been sent to make known the capabilities of portions of the western and northern coasts. Several of the colonies have equipped geological surveys, though they have not always cared to maintain them. A great deal of miscellaneous knowledge regarding the rocks of the country has thus been acquired, but it is scattered through hundreds of blue-books, reports, memoirs, transactions of societies, newspapers, and other publications. Those who are most familiar with Australian geology, can best judge whether the time has now come when this store of diffused information may be profitably condensed in the form of a general map of the whole country. Mr. Brough Smyth has deemed that it may, and accordingly he has produced the present map—the first general geological map of Australia which, so far as we are aware, has been published.

No one could have performed so well as Mr. Smyth the difficult task of compiling this map. From his official position as Secretary for Mines in Victoria, he has, of course, unequalled facilities for doing justice to his own Colony; and from correspondence with the government departments of the other colonies, he has obtained access to all the stores of information which successive surveys and expeditions have brought into the archives of the different governments. In the winter of 1872-3 he obtained the consent of his own government to his plan for elaborating a general map of Australia, and he immediately set to work to solicit information from all quarters. In his Progress Report, dated Oct. 1, 1873, he acknowledged the assistance already received from Queensland, Western Australia, South Australia, and Tasmania, but regretted the existence of many blanks, instancing in particular the want of a geological map of the important colony of New South Wales. The present map, however, bears the conspicuous date of April 25, 1873, though confessedly incomplete in October of that year, and not published until November 1875. Mr. Smyth's name alone appears on the title. No doubt he will take care to state fully in the text which it is proposed to issue in illustration of the map, the share which others have had in the real geological surveying of which he has so carefully gathered the fruit. Still, when we think of the many years of hard bodily and mental toil which such men as W. B. Clarke, Selwyn, Daintree, and others have given to the working out of Australian geology, we cannot help expressing a feeling of disappointment that on the fore-front of this first geological map of the country no place should have been found for their names.

With the exception of this omission, which may have arisen from inadvertence, and may yet be fully atoned for, little but the most unqualified praise is to be given to this map. We have already had occasion to call attention in this journal to Mr. Brough Smyth's great energy, and to the important services which he is rendering, not only to the industrial development of Victoria, but to the progress of geology. He has probably never accomplished, however, any task more likely to be of service in Australia or more useful to geologists in other countries than this first sketch of a geological map of that great region. Though the scale of the map is only $\frac{1}{7000000}$ or 110 miles to an inch, it is no doubt quite large enough for a beginning. It shows the salient features of the geology without too many confusing details. As a specimen of cartography, the map is one of the best which has recently appeared, and it does great credit to the taste and skill of the engravers and lithographers of the Mining Department at Melbourne, where it has been produced.

The first point about this map which will probably occur to most geologists is the comparatively large area over which it has been found possible to spread geological colours. The surveys and explorations of Queensland, New South Wales, Victoria, Southern and Western Australia, have sufficed to furnish materials for colouring most of the maritime tracts, as well as a large part of the eastern half of the continent. But it might have been supposed that in spite of the journals of the few adventurers who have crossed the interior, that great inland desert would have been left an uncoloured blank upon the map. Mr. Smyth, however, has made the most of every scattered notice and stray observation. He has, coloured the exploring tracks across the country in such a way as to suggest very clearly what must be the geological structure of the interior. The eastern mountain-chain bringing up the crystalline and older palæozoic rocks from Bass Strait to Torres Strait is well shown. On the western coast an enormous mass of granite is marked as stretching over fifteen degrees of latitude, and spreading far into the interior, where it seems to pass under the vast sheets of "desert sandstone," which occupy so much of the low interior of Australia. Carboniferous rocks are coloured over large spaces in Eastern Queensland, but the compiler of this map stops the tint

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[1] First sketch of a geological map of Australia, including Tasmania. By R. Brough Smyth, F.G.S., &c.